On AMPHIBAMUS GRANDICEPS, a new Batrachian from the Coal Measures.

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The recent additions to our knowledge of the air-breathing vertebrates of the carboniferous period, are of great interest to the comparative anatomist, as furnishing new points in the series of structures between the Ganoidea and Lacertilia, or new "generalized" types combining the structures of these and of the Batrachia.

I owe to Prof. Jos. Leidy, of our University, a specimen of a reptile, belonging to the Illinois State Survey, in charge of Messrs. Meek and Worthen. It was discovered by the latter near Morris, Grundy Co., Ill., in a bed belonging to the lower part of the coal measures. It is imbedded in a concretion of brown limestone. The casts of the bones are occupied by a white friable mineral, which has probably percolated into them.

This animal combines with its Batrachian, a few Lacertilian characters, having some resemblance to Dawson's genus Hylonomus, and much affinity with Prof. Wyman's Ranceps l y e l l i i. Its squamous integument and narrow nasal roof give it the somewhat Lacertilian physiognomy, more especially Geccotian, in its broad cranium and orbits, its large marginal palpebral scales, and rather short digits. Its true affinities are indicated by the presence of two premaxillaries, with a squamoso-postorbital arch, as in Labyrinthodontia, some Batrachia Gradientia, and Crocodilia; its quadratojugal arch as in Labyrinthodontia and Batrachia Salientia; its posteriorly directed oblique quadratum and lack of ribs, as in Batrachia Salientia; its probably short pelvis, short separate bones of the leg and fore-arm; its opisthocælian dorsal vertebræ, and long caudal neural spines, as in Batrachia Gradientia. It is then the type of a group intermediate between the Labyrinthodontian and Gradient Batrachians, distinguished from the former by the opisthocoelian vertebræ, absence of ribs, and pleurodont dentition; and from the latter by the scaly integument, absence of ribs, and structure of the nasal and prefrontal regions. But one genus of Salamanders, Glossolega, has a similar os quadrato-jugale, and but a part of one family, the Salamandridæ, the postfronto-squamosal or posterior zygomatic arch. A ribless type might, however, well exist among Gradientia, when we consider the great difference between their developement in Pleurodeles on the one hand, and Amphiuma on the other. From the Salientia the dentigerous mandible, squamosal arch, form of vertebræ, sacrum and extremities, etc., widely distinguish it. To the Batrachian orders Labyrinthodontia, Gradientia, Gymnophidia and Salientia, the present may be added, under the name Xenorachia.

The general form of the skull is much that of a frog, and large in proportion to the size of the animal; its length is one-half that of the spinal axis from the occiput to the middle of the sacral region, and five-sixths its own breadth in the flattened specimen. The outline is not broadly rounded, as is usual among Salamanders, but is slightly contracted, as in many frogs. The orbits are large, regularly rounded, their longitudinal diameter one and one-half times the frontal width; their point of nearest approach is behind opposite the position of the iris; one diameter measured obliquely, in advance of each extends a little beyond the common premaxillary suture.

The premaxillary bones have considerable horizontal extent, terminating opposite the narial openings, each bearing eleven or twelve teeth. Their nasal spines were in close contact, and do not appear to be prolonged backwards, as in most Gradientia. The external nares are rather widely separated, as in most Gradientia, the integument which they pierced roofing a large space between the median and peripheric bones of the muzzle. The roof of the nasal cavities is a truncate cuneiform plate, whose apex joins that of the premaxillaries. Its composition can only be conjectured, from the appearances presented by the specimen. It may be a superior ethmoid plate, as in the frogs

Borborocoetes and others, or, more probably, a united or separate pair of free frontal, as in Dactylethra or Rana. There is no trace of the composition of nasals and frontals which occurs in the Gradientia, nor is such an arrangement probable, in view of the regular elongate cuneiform outline of this singular piece. A moderately distinct suture crossing the front at the anterior third of the interorbital space, which presents a regular convexity forwards, appears to be the anterior border of the frontal; the latter can scarcely be an interorbital plate of ethmoid, as it appears to unite behind by suture with the parietals. There are bosses on the prefrontal region indicating prefrontal or "lachrymal" bones similar to those in Sceloporus and other Lacertilian genera.

What I suppose to be the coronal suture, since it appears to be too regular to be a fracture, crosses the narrowest part of the interorbital space; it is a zigzag, presenting posteriorly a median angle, and one on each side. The posterior zygomatic arches are strong, and bound a cranial plane, which is broader than long, and exhibits nearly parallel lateral outlines. The probably small "crotaphite foramina" of the temporal fossæ appear to have been roofed over by perhaps the strong scales of the cranial integument. The quadratum is convex externally, and is directed obliquely backward to opposite the occiput; it is strongly concave in its posterior outline, indicating a large auricular meatus. Whether this was covered by scales or by an exposed tympanic drum, cannot be determined. The quadratojugale is broad and strong. The postorbital arch is continuous with the quadratum; the breadth of the two equals the frontal width. The angular process of the mandible is but little prolonged beyond the quadratum. The maxillary is toothed at least as far as opposite the malar process.

The dentition is pleurodont; the teeth are only visible on the mandible and the outer edge of the upper jaw; they are there of but one kind, small, closely set, acute-conic, not compressed, hollow, and without any inflections of the enamel.

The integument of the head was squamous. The scales appear not to have been imbricate, and were perhaps more dense on the posterior regions, where their position is occupied by the white material before spoken of, which has here a somewhat ganoid appearance. They were more elongate on the muzzle. There appears to have been a distinct superciliary, and a postorbital row, as well as a series on the border of the upper lip. A whorl of elongate scales arranged like the pieces of an arch, surrounded the one on each side which marked the crotaphite foramen. In the specimen these are connected by a suture or line, which is regularly convex posteriorly. The superior palpebræ were covered by small separated scales, as are seen among Geccos and Anoles, and were bordered by a larger and continuous series, of about fourteen subquadrate scales. These have evidently bordered the lid, extending transversely across the orbit, and were not sclerotic scales, which are arranged round the pupil as a centre.

The vertebral column is much injured, especially in the cervical region. The dorsal vertebræ appear to have been short, and probably thirteen in number between the interscapular and sacral regions. They appear to have been constricted medially. Traces of ribs or of transverse processes are not to be found. The impression of a sacral vertebra is distinctly preserved. The caudal vertebræ were perhaps without osseous centra, as no definite impressions can be traced, and their place is occupied by the matrix. There are traces of osseous neural arches, perhaps similar to those of Archegosaurus, and apparently disconnected, long, compressed neural spines, and slender pleurapophyses; the latter were probably united as chevron bones. Of the former, twelve very distinct impressions may be counted to the sacral region; the posterior are most slender, the median most elevated, the anterior lower, and of greater longitudinal extent. They are more expanded in the direction

of the axis of the body near their superior extremities, and evidently supported a flattened natatory tail, as that of Protonopsis. These neural spines were continued on the posterior third of the dorsal series. The visible, which is probably the greater part of the tail, enters the remainder of the column two and a quarter times, by measurement.

Sternal and hyoid pieces are not recognizable, though sundry fragments are no donbt to be referred to these regions. An impression resembling that of a raniform scapula, was probably made by that piece. The anterior limbs were short and weak. The humerus is slender; its length equals the distance between the centres of the external nares; it is apparently not much dilated, nor furnished with a process proximally, but is dilated and grooved distally, and has no condyles. The ulna and radius are separate and slender: the distal extremities of these, with the remaining bones of the anterior limbs, have been lost.

Of pelvis nothing is recognizable. The femur is slender, much dilated distally, slightly curved in the posterior direction, and without condyles. Its length is equal to the breadth of the cranial table.

The tibia and fibula are one-half the length of the femur, are slender, most dilated proximally; the antero-exterior bone is a little longer, not in contact with the inner distally, which relation I believe to be normal. The tarsus was probably cartilaginous, as in Protonopsis (*Menopoma*), a faint impression of the outer border remaining. It was broader than long, and without heel-like projections.

While the great shortness of the lower leg is a Salamandrine peculiarity, the length and slenderness of the digits are quite Lacertian. The leg being extended backward, the exterior or first digit is shortest, and a little less than the second. This is equal to two and one-half phalanges of the fifth, (reckoning from its base,) or the proximal pair of phalanges of the fourth. The fifth is a little shorter than the third, which is scarcely equal to the three proximal phalanges of the fourth. The number of phalanges is 3—3—4—5—4: among the Salamanders the last two numbers are usually 4—3. They are without condyles, but exhibit one or two emarginations at their articulating surfaces. The length of the basal phalanx of the first digit is two-thirds that of the second; the latter equals that of the fifth and the second phalanx of the fourth; these are very little shorter than the basal of the third and fourth. The terminal phalanges are elongate acute, those of the first and fourth slightly curved. They are much less obtuse than in Salamanders, and the animal has probably had weak claws: of these no trace remains.

A few traces indicate that the dermal integument was covered on the anterior part of the body, at least, with small and subgranular scales. There have been abdominal scales arranged in narrow imbricate series, directed inward and posteriorly. Traces of plates are wanting, excepting a small fragment lying beside the cervical vertebræ.

The length of this species from the sacral centre to the interscapular region, was 13 lines; from the latter point to the end of the muzzle, 12 lines; to the occipital border, 4·5 lines. Longitudinal diameter of orbit, 3 lines; frontal breadth, 2 lines; from border of orbit to border of nostril, 1·5 lines; breadth of cranial table, 3·75 lines. Length of humerus 3 lines; of femur, 3·6 lines; of tibia, 2·3 lines; of fifth digit, 2·75 lines; of fourth, 4·2 lines; of first, 1·8 lines. The portion of the tail preserved measures 5·2 lines.

If we compare the peculiarities of this genus with those of the Batrachia of the same period, we find it to be distinguished, independently of the ordinal characters, from such genera as Osteophorus, Melosaurus, Sclerocephalus, Xestorrhytias, Baphetes, and Brachyops, by the absence of the sculpturing of the cranial bones, the lack of dermal shields, characteristic of most of these, and by the presence of cranial and palpebral scales. The crania of the first genera are much more elongate, and imitate those of some Crocо-

dilia. Similar differences exist between the Illinois Batrachian and Dendrerpeton (Owen); the latter possesses also a double row of teeth. Hylonomus, (Dawson), supposed to possess Lacertilian affinities, exhibits ribs and biconcave vertebræ. The ribs of Telerpeton will distinguish it also. The only genus as yet known to approach closely that under consideration, has been described by Prof. J. Wyman under the name of Raniceps.* This animal is only known from a study of the inferior aspect of a portion of the skeleton; nevertheless it is certainly different, being nearly double the size, and having relatively longer and stronger anterior limbs. The angles of the mandible appear to have been considerably more incurved than in the Illinois species. They may have belonged to the same genus; in that case the name here given will not prove superfluous, as the older appellation was previously applied to a genus of Gadid fishes.

The name Amphibamus grandiceps has reference, first, to its two modes of progression; its flattened oar-like tail enabled it to swim in the waters of the swamps of the coal period, and its elongate, clawed digits indicate ambulatory power; perhaps it climbed upon the low limbs of the Sigillariæ that rose above the water. The animal was most probably nocturnal in its habits. The humors of the eye could not have escaped far beyond their natural envelopes, so that the subsequently formed limestone has been hardened, and so fractured in nearly the form of the ball. On the fractured surface below and under the remaining palpebral scales, the mineral is distinctly blackened, as by the pigmentum nigrum; below the margin of the lid this is interrupted by a discoid spot of the form and dimensions of an iris, which presents a median lenticular vacuity, again revealing the pigment, obviously the vertical pupil of a nocturnal animal. The preservation of the outline of color is certainly remarkable in a specimen of such great antiquity. A somewhat parallel case occurs in the preservation of the ink-bags of the Sepiæ; these do not date further back than the Jurassic. These appearances cannot be explained on any supposition of artificial production.

August 1st.

MR. CASSIN, Vice President, in the Chair.

Twelve members present.

The following paper was read and referred to a committee:

"Descriptions of new species of fossil Crinoidea, &c." By F. B. Meek and A. H. Worthen.

August 8th.

DR RUSCHENBERGER, in the Chair.

Ten members present.

The following papers were read and referred to committees:

"Notes on a species of Whale found in the River Delaware." By E. D. Cope.

"On some Conirostral Birds from Costa Rica." By John Cassin.

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* Amer. Journ. Sci. and Arts, 1858, p. 158.